

# Drug Overdose Deaths in the United States, 1999–2016

Holly Hedegaard, M.D., Margaret Warner, Ph.D., and Arialdi M. Miniño, M.P.H.

## Key findings

### Data from the National Vital Statistics System, Mortality

- In 2016, there were more than 63,600 drug overdose deaths in the United States.
- The age-adjusted rate of drug overdose deaths in 2016 (19.8 per 100,000) was 21% higher than the rate in 2015 (16.3).
- Among persons aged 15 and over, adults aged 25–34, 35–44, and 45–54 had the highest rates of drug overdose deaths in 2016 at around 35 per 100,000.
- West Virginia (52.0 per 100,000), Ohio (39.1), New Hampshire (39.0), the District of Columbia (38.8), and Pennsylvania (37.9) had the highest observed age-adjusted drug overdose death rates in 2016.
- The age-adjusted rate of drug overdose deaths involving synthetic opioids other than methadone (drugs such as fentanyl, fentanyl analogs, and tramadol) doubled between 2015 and 2016, from 3.1 to 6.2 per 100,000.

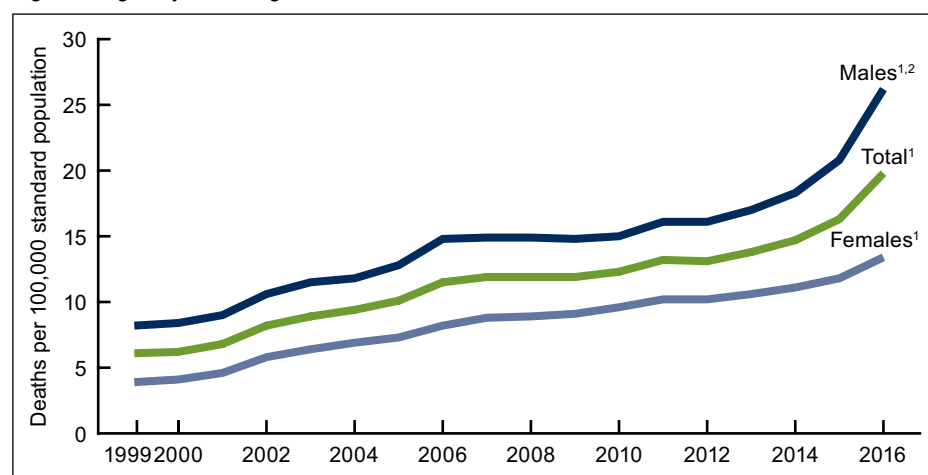
Deaths from drug overdose are an increasing public health burden in the United States (1–4). This report uses the most recent data from the National Vital Statistics System (NVSS) to update trends in drug overdose deaths, describe demographic and geographic patterns, and identify shifts in the types of drugs involved.

*Keywords: poisoning • opioids • heroin • National Vital Statistics System Mortality File*

## In 2016, the age-adjusted rate of drug overdose deaths in the United States was more than three times the rate in 1999.

- In 2016, there were more than 63,600 drug overdose deaths in the United States (Figure 1).
- The age-adjusted rate of drug overdose deaths increased from 6.1 per 100,000 standard population in 1999 to 19.8 in 2016 (Figure 1). The rate

Figure 1. Age-adjusted drug overdose death rates: United States, 1999–2016



<sup>1</sup>Significant increasing trend from 1999 to 2016 with different rates of change over time,  $p < 0.001$ .

<sup>2</sup>2016 rate for males was significantly higher than for females,  $p < 0.001$ .

NOTES: Deaths are classified using the *International Classification of Diseases, Tenth Revision*. Drug-poisoning (overdose) deaths are identified using underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. The number of drug overdose deaths in 2016 was 63,632. Access data table for Figure 1 at:

[https://www.cdc.gov/nchs/data/databriefs/db294\\_table.pdf#1](https://www.cdc.gov/nchs/data/databriefs/db294_table.pdf#1).

SOURCE: NCHS, National Vital Statistics System, Mortality.



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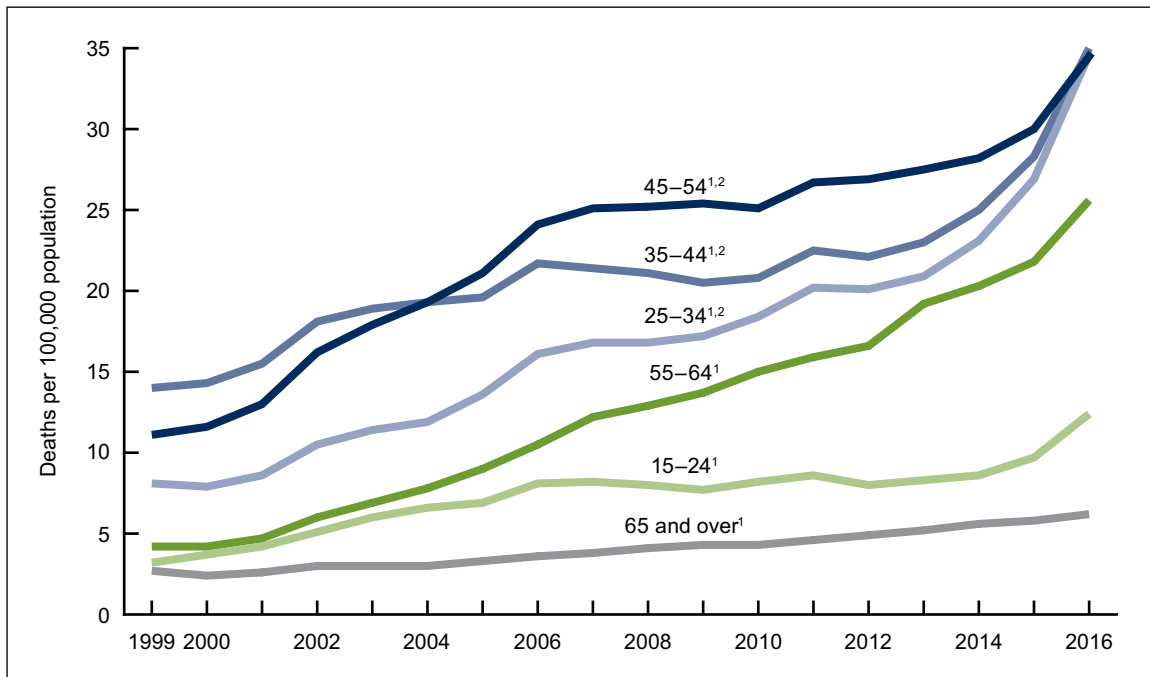
increased on average by 10% per year from 1999 to 2006, by 3% per year from 2006 to 2014, and by 18% per year from 2014 to 2016.

- Rates were significantly higher for males than females. For males, the rate increased from 8.2 in 1999 to 26.2 in 2016. For females, the rate increased from 3.9 in 1999 to 13.4 in 2016.

### Among persons aged 15 and over, adults aged 25–34, 35–44, and 45–54 had the highest rates of drug overdose deaths in 2016.

- The rates of drug overdose deaths increased from 1999 to 2016 for all age groups studied (Figure 2).
- Rates in 2016 were highest for persons aged 25–34 (34.6 per 100,000), 35–44 (35.0), and 45–54 (34.5).
- From 2015 to 2016, the greatest percentage increase in the drug overdose death rates occurred among adults aged 15–24, 25–34, and 35–44 with increases of 28%, 29%, and 24%, respectively.
- From 2015 to 2016, the drug overdose death rates for adults aged 45–54, 55–64, and 65 and over increased 15%, 17%, and 7% respectively.

Figure 2. Drug overdose death rates, by selected age group: United States, 1999–2016



<sup>1</sup>Significant increasing trend from 1999 to 2016 with different rates of change over time,  $p < 0.005$ .

<sup>2</sup>2016 rate was significantly higher than for the rate for age groups 15–24, 55–64, and 65 and over,  $p < 0.05$ .

NOTES: Deaths are classified using the *International Classification of Diseases*, Tenth Revision. Drug-poisoning (overdose) deaths are identified using underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. Access data table for Figure 2 at: [https://www.cdc.gov/nchs/data/databriefs/db294\\_table.pdf#2](https://www.cdc.gov/nchs/data/databriefs/db294_table.pdf#2).

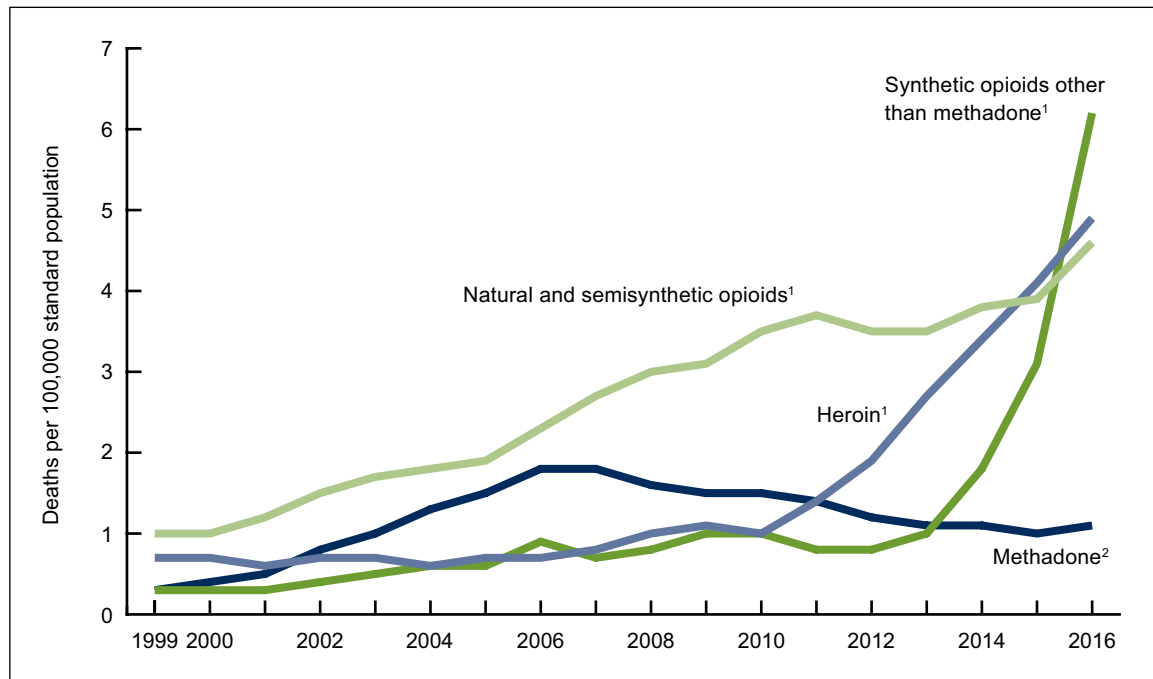
SOURCE: NCHS, National Vital Statistics System, Mortality.



## The age-adjusted rate of drug overdose deaths involving synthetic opioids other than methadone doubled from 2015 to 2016.

- The rate of drug overdose deaths involving synthetic opioids other than methadone, which include drugs such as fentanyl, fentanyl analogs, and tramadol, increased from 0.3 per 100,000 in 1999 to 1.0 in 2013, 1.8 in 2014, 3.1 in 2015, and 6.2 in 2016 (Figure 4). The rate increased on average by 18% per year from 1999 to 2006, did not statistically change from 2006 to 2013, then increased by 88% per year from 2013 to 2016.
- The rate of drug overdose deaths involving heroin increased from 0.7 in 1999, to 1.0 in 2010, to 4.9 in 2016. The rate was steady from 1999 to 2005, then increased on average by 10% per year from 2005 to 2010, by 33% per year from 2010 to 2014, and by 19% from 2014 to 2016.
- The rate of drug overdose deaths involving natural and semisynthetic opioids, which include drugs such as oxycodone and hydrocodone, increased from 1.0 in 1999 to 4.4 in 2016. The rate increased on average by 13% per year from 1999 to 2009 and by 3% per year from 2009 to 2016.
- The rate of drug overdose deaths involving methadone increased from 0.3 in 1999 to 1.8 in 2006, then declined to 1.0 in 2016.

Figure 4. Age-adjusted drug overdose death rates, by opioid category: United States, 1999–2016



<sup>1</sup>Significant increasing trend from 1999 to 2016 with different rates of change over time,  $p < 0.05$ .

<sup>2</sup>Significant increasing trend from 1999 to 2006, then decreasing trend from 2006 to 2016,  $p < 0.05$ .

NOTES: Deaths are classified using the *International Classification of Diseases, Tenth Revision*. Drug-poisoning (overdose) deaths are identified using underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. Drug overdose deaths involving selected drug categories are identified by specific multiple-cause-of-death codes: heroin, T40.1; natural and semisynthetic opioids, T40.2; methadone, T40.3; and synthetic opioids other than methadone, T40.4. Deaths involving more than one opioid category (e.g., a death involving both methadone and a natural or semisynthetic opioid) are counted in both categories. The percentage of drug overdose deaths that identified the specific drugs involved varied by year, with ranges of 75%–79% from 1999 to 2013, and 81%–85% from 2014 to 2016. Access data table for Figure 4 at: [https://www.cdc.gov/nchs/data/databriefs/db294\\_table.pdf#4](https://www.cdc.gov/nchs/data/databriefs/db294_table.pdf#4).

SOURCE: NCHS, National Vital Statistics System, Mortality.

## Summary

This report updates statistics on deaths from drug overdoses in the United States and includes information on trends since 1999 as well as key findings for 2016.

The rates of drug overdose deaths continued to increase. In 2016, the age-adjusted rate of drug overdose deaths (19.8 per 100,000) was more than three times the rate in 1999 (6.1). Rates increased for both males (from 8.2 in 1999 to 26.2 in 2016) and females (from 3.9 in 1999 to 13.4 in 2016). Rates also increased for all age groups studied. In 2016, among persons aged 15 and over, rates were highest for adults aged 25–34, 35–44, and 45–54, at about 35 per 100,000. From 2015 to 2016, drug overdose death rates increased 28% for persons aged 15–24, 29% for persons aged 25–34, 24% for persons aged 35–44, 15% for persons aged 45–54, 17% for persons aged 55–64, and 7% for persons aged 65 and over. In 2016, 22 states and the District of Columbia had age-adjusted drug overdose death rates that were statistically higher than the national rate; 5 states had rates that were comparable to the national rate; and 23 states had lower rates.

The pattern of drugs involved in drug overdose deaths has changed in recent years. The rate of drug overdose deaths involving synthetic opioids other than methadone (drugs such as fentanyl, fentanyl analogs, and tramadol) doubled in a single year from 3.1 per 100,000 in 2015 to 6.2 in 2016. Rates of drug overdose deaths involving heroin increased from 4.1 in 2015 to 4.9 in 2016. Rates of drug overdose deaths involving natural and semisynthetic opioids increased from 3.9 in 2015 to 4.4 in 2016.

## Definitions

Drug poisoning (overdose) deaths: Includes deaths resulting from unintentional or intentional overdose of a drug, being given the wrong drug, taking a drug in error, or taking a drug inadvertently.

Natural and semisynthetic opioids: Includes such drugs as morphine, codeine, hydrocodone, and oxycodone.

Synthetic opioids other than methadone: Includes such drugs as fentanyl, fentanyl analogs, and tramadol.

## Data source and methods

Estimates are based on the NVSS multiple-cause-of-death mortality files (5). Drug poisoning (overdose) deaths were defined as having an *International Classification of Diseases, Tenth Revision* (ICD–10) underlying-cause-of-death code of X40–X44 (unintentional), X60–X64 (suicide), X85 (homicide), or Y10–Y14 (undetermined intent). Of the drug overdose deaths in 2016, 86% were unintentional, 8% were suicides, 6% were of undetermined intent, and less than 1% were homicides. The type of drug(s) involved are indicated by ICD–10 multiple-cause-of-death codes: heroin (T40.1), natural and semisynthetic opioids (T40.2), methadone (T40.3), and synthetic opioids other than methadone (T40.4).

Age-adjusted death rates were calculated using the direct method and adjusted to the 2000 standard population (6). Differences between national and state estimates were evaluated using two-sided significance tests at the 0.01 level, with the national rate treated as a fixed parameter. Trends in death rates were evaluated using the Joinpoint Regression Program (7). Unless otherwise stated, all comparisons described are statistically significant at the 0.05 level of significance.

Several factors related to death investigation and reporting may affect measurement of death rates involving specific drugs. At autopsy, the substances tested for and the circumstances under which the toxicology tests are performed vary by jurisdiction. This variability is likely to affect substance-specific death rates more than the overall drug overdose death rate. The percentage of drug overdose deaths that identified the specific drugs involved varied by year, with ranges of 75%–79% from 1999 to 2013, and 81%–85% from 2014 to 2016.

Additionally, drug overdose deaths may involve multiple drugs; therefore, a single death might be included in more than one category when describing the rate of drug overdose deaths involving specific drugs. For example, a death that involved both heroin and fentanyl would be included in both the rate of drug overdose deaths involving heroin and the rate of drug overdose deaths involving synthetic opioids other than methadone.

## About the authors

Holly Hedegaard is with the National Center for Health Statistics (NCHS), Office of Analysis and Epidemiology. Margaret Warner and Arialdi M. Miniño are with the NCHS Division of Vital Statistics.

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**Data Brief 294. Drug Overdose Deaths in the United States, 1999–2016**

**Data table for Figure 1. Age-adjusted drug overdose death rates: United States, 1999–2016**

Year	Total		Male		Female	
	Number	Deaths per 100,000	Number	Deaths per 100,000	Number	Deaths per 100,000
1999	16,849	6.1	11,258	8.2	5,591	3.9
2000	17,415	6.2	11,563	8.3	5,852	4.1
2001	19,394	6.8	12,658	9.0	6,736	4.6
2002	23,518	8.2	15,028	10.6	8,490	5.8
2003	25,785	8.9	16,399	11.5	9,386	6.4
2004	27,424	9.4	17,120	11.8	10,304	6.9
2005	29,813	10.1	18,724	12.8	11,089	7.3
2006	34,425	11.5	21,893	14.8	12,532	8.2
2007	36,010	11.9	22,298	14.9	13,712	8.8
2008	36,450	11.9	22,468	14.9	13,982	8.9
2009	37,004	11.9	22,593	14.8	14,411	9.1
2010	38,329	12.3	23,006	15.0	15,323	9.6
2011	41,340	13.2	24,988	16.1	16,352	10.2
2012	41,502	13.1	25,112	16.1	16,390	10.2
2013	43,982	13.8	26,799	17.0	17,183	10.6
2014	47,055	14.7	28,812	18.3	18,243	11.1
2015	52,404	16.3	32,957	20.8	19,447	11.8
2016	63,632	19.8	41,558	26.2	22,074	13.4

NOTES: Deaths are classified using the *International Classification of Diseases, Tenth Revision* (ICD–10). Drug-poisoning (overdose) deaths are identified using ICD–10 underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14.

SOURCE: NCHS, National Vital Statistics System, Mortality.

**Data Brief 294. Drug Overdose Deaths in the United States, 1999–2016**

**Data table for Figure 2. Drug overdose death rates, by selected age group: United States, 1999–2016**

Year	15–24		25–34		35–44		45–54		55–64		65 and over	
	Number	Deaths per 100,000	Number	Deaths per 100,000	Number	Deaths per 100,000	Number	Deaths per 100,000	Number	Deaths per 100,000	Number	Deaths per 100,000
1999	1,240	3.2	3,236	8.1	6,295	14.0	4,067	11.1	991	4.2	930	2.7
2000	1,435	3.7	3,169	7.9	6,469	14.3	4,389	11.6	1,013	4.2	854	2.4
2001	1,700	4.2	3,410	8.6	6,968	15.5	5,115	13.0	1,185	4.7	910	2.6
2002	2,095	5.1	4,125	10.5	8,064	18.1	6,466	16.2	1,601	6.0	1,060	3.0
2003	2,491	6.0	4,488	11.4	8,358	18.9	7,325	17.9	1,943	6.9	1,070	3.0
2004	2,751	6.6	4,680	11.9	8,439	19.3	8,040	19.3	2,283	7.8	1,104	3.0
2005	2,918	6.9	5,340	13.6	8,506	19.6	8,968	21.1	2,761	9.0	1,203	3.3
2006	3,460	8.1	6,346	16.1	9,373	21.7	10,421	24.1	3,355	10.5	1,321	3.6
2007	3,550	8.2	6,663	16.8	9,152	21.4	11,012	25.1	4,043	12.2	1,435	3.8
2008	3,487	8.0	6,739	16.8	8,885	21.1	11,222	25.2	4,396	12.9	1,587	4.1
2009	3,377	7.7	7,013	17.2	8,524	20.5	11,390	25.4	4,858	13.7	1,721	4.3
2010	3,571	8.2	7,572	18.4	8,546	20.8	11,299	25.1	5,486	15.0	1,722	4.3
2011	3,762	8.6	8,445	20.2	9,130	22.5	11,933	26.7	6,060	15.9	1,892	4.6
2012	3,518	8.0	8,508	20.1	8,948	22.1	11,895	26.9	6,423	16.6	2,094	4.9
2013	3,664	8.3	8,947	20.9	9,320	23.0	12,045	27.5	7,551	19.2	2,344	5.2
2014	3,798	8.6	10,055	23.1	10,134	25.0	12,263	28.2	8,122	20.3	2,568	5.6
2015	4,235	9.7	11,880	26.9	11,505	28.3	12,974	30.0	8,901	21.8	2,760	5.8
2016	5,376	12.4	15,443	34.6	14,183	35.0	14,771	34.5	10,632	25.6	3,075	6.2

NOTES: Deaths are classified using the *International Classification of Diseases, Tenth Revision* (ICD–10). Drug-poisoning (overdose) deaths are identified using ICD–10 underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14.

SOURCE: NCHS, National Vital Statistics System, Mortality.

**Data Brief 294. Drug Overdose Deaths in the United States, 1999–2016**

**Data table for Figure 3. Age-adjusted drug overdose death rates, by state: United States, 2016**

State	Number	Deaths per 100,000
Alabama	756	16.2
Alaska	128	16.8
Arizona	1,382	20.3
Arkansas	401	14.0
California	4,654	11.2
Colorado	942	16.6
Connecticut	971	27.4
Delaware	282	30.8
District of Columbia	269	38.8
Florida	4,728	23.7
Georgia	1,394	13.3
Hawaii	191	12.8
Idaho	243	15.2
Illinois	2,411	18.9
Indiana	1,526	24.0
Iowa	314	10.6
Kansas	313	11.1
Kentucky	1,419	33.5
Louisiana	996	21.8
Maine	353	28.7
Maryland	2,044	33.2
Massachusetts	2,227	33.0
Michigan	2,347	24.4
Minnesota	672	12.5
Mississippi	352	12.1
Missouri	1,371	23.6
Montana	119	11.7
Nebraska	120	6.4
Nevada	665	21.7
New Hampshire	481	39.0
New Jersey	2,056	23.2
New Mexico	500	25.2
New York	3,638	18.0
North Carolina	1,956	19.7
North Dakota	77	10.6
Ohio	4,329	39.1
Oklahoma	813	21.5
Oregon	506	11.9
Pennsylvania	4,627	37.9
Rhode Island	326	30.8
South Carolina	879	18.1
South Dakota	69	8.4
Tennessee	1,630	24.6
Texas	2,831	10.1
Utah	635	22.3
Vermont	125	22.2
Virginia	1,405	16.7
Washington	1,102	14.5
West Virginia	884	52.0
Wisconsin	1,074	19.3
Wyoming	99	17.6

NOTES: Deaths are classified using the *International Classification of Diseases, Tenth Revision* (ICD–10). Drug-poisoning (overdose) deaths are identified using ICD–10 underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. The age-adjusted drug overdose death rate in the U.S. in 2016 was 19.8 per 100,000 standard population.

SOURCE: NCHS, National Vital Statistics System, Mortality.

**Data Brief 294. Drug Overdose Deaths in the United States, 1999–2016**

**Data table for Figure 4. Age-adjusted drug overdose death rates, by opioid category: United States, 1999–2016**

Year	Any opioid		Heroin		Natural and semisynthetic opioids		Methadone		Synthetic opioids other than methadone	
	Number	Deaths per 100,000	Number	Deaths per 100,000	Number	Deaths per 100,000	Number	Deaths per 100,000	Number	Deaths per 100,000
1999	8,050	2.9	1,960	0.7	2,749	1.0	784	0.3	730	0.3
2000	8,407	3.0	1,842	0.7	2,917	1.0	986	0.4	782	0.3
2001	9,496	3.3	1,779	0.6	3,479	1.2	1,456	0.5	957	0.3
2002	11,920	4.1	2,089	0.7	4,416	1.5	2,358	0.8	1,295	0.4
2003	12,940	4.5	2,080	0.7	4,867	1.7	2,972	1.0	1,400	0.5
2004	13,756	4.7	1,878	0.6	5,231	1.8	3,845	1.3	1,664	0.6
2005	14,918	5.1	2,009	0.7	5,774	1.9	4,460	1.5	1,742	0.6
2006	17,545	5.9	2,088	0.7	7,017	2.3	5,406	1.8	2,707	0.9
2007	18,516	6.1	2,399	0.8	8,158	2.7	5,518	1.8	2,213	0.7
2008	19,582	6.4	3,041	1.0	9,119	3.0	4,924	1.6	2,306	0.8
2009	20,422	6.6	3,278	1.1	9,735	3.1	4,696	1.5	2,946	1.0
2010	21,089	6.8	3,036	1.0	10,943	3.5	4,577	1.5	3,007	1.0
2011	22,784	7.3	4,397	1.4	11,693	3.7	4,418	1.4	2,666	0.8
2012	23,166	7.4	5,925	1.9	11,140	3.5	3,932	1.2	2,628	0.8
2013	25,052	7.9	8,257	2.7	11,346	3.5	3,591	1.1	3,105	1.0
2014	28,647	9.0	10,574	3.4	12,159	3.8	3,400	1.1	5,544	1.8
2015	33,091	10.4	12,989	4.1	12,727	3.9	3,301	1.0	9,580	3.1
2016	42,249	13.3	15,469	4.9	14,487	4.4	3,373	1.0	19,413	6.2

NOTES: Deaths are classified using the *International Classification of Diseases, 10th Revision* (ICD–10). Drug-poisoning (overdose) deaths are identified using ICD–10 underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14. Among deaths with drug overdose as the underlying cause, the following multiple cause-of-death codes indicate the drug type(s) involved: Any opioid (T40.0–T40.4, T40.6), heroin (T40.1), natural and semisynthetic opioids (T40.2), methadone (T40.3), and synthetic opioids other than methadone (T40.4). Deaths involving more than one opioid category (e.g., a death involving both methadone and a natural or semisynthetic opioid such as oxycodone) are counted in both categories. Natural and semisynthetic opioids include drugs such as morphine, oxycodone, and hydrocodone; and synthetic opioids other than methadone include drugs such as fentanyl, fentanyl analogs and tramadol. The percentage of drug overdose deaths that identified the specific drugs involved varied by year, with ranges of 75%–79% from 1999 to 2013, and 81%–85% from 2014 to 2016.

SOURCE: NCHS, National Vital Statistics System, Mortality.